9.10 Name one ionic compound that contains a polyatomic cation and a polyatomic anion (see Table 2.3).
命名包含多原子陽離子和原子陰離子一個離子型化合物

9.20 For each of the following pairs of elements, state whether the binary compound they form is likely to be ionic or covalent. Write the empirical formula and name of the compound: (a) B and F, (b) K and Br.
為每個下面對元件的，說明它們形成二元化合物是否很可能是離子的或共價的。寫的化合物的經驗式和名稱：（一）B 和 F，（二）K 和 Br。

9.20 (a) Covalent (BF_3, boron trifluoride) **(b)** ionic (KBr, potassium bromide)

9.30 How many lone pairs are on the underlined atoms in these compounds? HBr, H2S, CH4
多少孤對都在這些化合物中帶下劃線的原子？的 HBr，H 2 S，CH 4

9.40 Classify the following bonds as ionic, polar covalent, or covalent, and give your reasons: (a) the SiSi bond in Cl3SiSiCl3, (b) the SiCl bond in Cl3SiSiCl3, (c) the CaF bond in CaF2, (d) the NH bond in NH3.
分類以下鍵作為離子，極性共價或共價，並給出你的理由：（一）SISI 鍵在 Cl3SiSiCl3，（二）SiCl 鍵在 Cl3SiSiCl3，（C）CAF 中鍵的氟化鈣，（四）NH 鍵在 NH3。

9.40 (a) The two silicon atoms are the same. The bond is covalent.

(b) The electronegativity difference between Cl and Si is 3.0 − 1.8 = 1.2. The bond is polar covalent.

(c) The electronegativity difference between F and Ca is 4.0 − 1.0 = 3.0. The bond is ionic.

(d) The electronegativity difference between N and H is 3.0 − 2.1 = 0.9. The bond is polar covalent.

9.50 Is it possible to “trap” a resonance structure of a compound for study? Explain.
是否有可能“固定”進行研究的化合物的共振結構？ 說明。

9.60 What is a coordinate covalent bond? Is it different from a normal covalent bond?
什麼是 coordinate covalent bond？它有什麼不同？

9.70 For the reaction O(g) 1 O2(g) ¡ O3(g) ¢H° 5 2107.2 kJ/mol Calculate the average bond enthalpy in O3.
對於反應計算的平均鍵焓在 O3。

9.70 Strategy: Keep in mind that bond breaking is an energy absorbing (endothermic) process and bond making is an energy releasing (exothermic) process. Therefore, the overall energy change is the difference between these two opposing processes, as described in Equation (9.3) of the text.

Solution: There are two oxygen-to-oxygen bonds in ozone. We will represent these bonds as O−O. However, these bonds might not be true oxygen-to-oxygen single bonds. Using Equation (9.3) of the text, we write: 策略：請記住，鍵斷裂是一個能量吸收（吸熱）的過程和鍵制定是一種能量釋放（放熱）過程。因此，總的能量變化之間的差別這兩個相對的過程，如等式（9.3）中描述的文本。溶液：有兩個氧 - 氧鍵在臭氧。我們將代表這些鍵為 O-O。然而，這些鍵可能不是真實的氧 - 氧單鍵的。使用文本式（9.3），我們寫：

$$\Delta H^\circ = \sum \text{BE(reactants)} - \sum \text{BE(products)}$$

$$\Delta H^\circ = \text{BE(O=O)} - 2\text{BE(O–O)}$$

In the problem, we are given ΔH° for the reaction, and we can look up the O=O bond enthalpy in Table 9.4 of the text. Solving for the average bond enthalpy in ozone,
在這個問題中，我們給出了Δ H°的反應，我們可以看一下 O = O 鍵焓在表 9.4

文本。求解平均鍵焓臭氧，

$$-2\text{BE(O–O)} = \Delta H^\circ - \text{BE(O=O)}$$

$$\text{BE(O – O)} = \frac{\text{BE(O=O)} - \Delta H^\circ}{2} = \frac{498.7\ \text{kJ/mol} + 107.2\ \text{kJ/mol}}{2} = \mathbf{303.0\ kJ\ /\ mol}$$

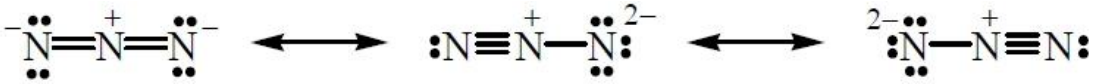
Considering the resonance structures for ozone, is it expected that the O−O bond enthalpy in ozone is between the single O−O bond enthalpy (142 kJ) and the double O=O bond enthalpy (498.7 kJ)?

考慮到共振結構臭氧，是它預計將 O-O 鍵焓的臭氧單 O-O 鍵焓（142 千焦）和雙 O = O 鍵焓（498.7 千焦）之間？

9.80 Write three reasonable resonance structures for the azide ion N2 3 in which the atoms are arranged as NNN. Show formal charges.

寫三個合理共振結構的疊氮離子 N 23，其中原子的排列作為 NNN。展示形式電荷。

9.80 The resonance structures are:



Which is the most plausible structure based on a formal charge argument?

9.90 Which of the following molecules has the shortest nitrogen-to-nitrogen bond? Explain. N2H4, N2O, N2, N2O4

其中以下分子具有最短的氮與氮鍵？ 說明。 N 2 H 4，N 2 O，N 2，N2O4

9.90 Only **N2** has a triple bond. Therefore, it has the shortest bond length.

9.100 Several resonance structures for the molecule CO2 are shown next. Explain why some of them are likely to be of little importance in describing the bonding in this molecule.

一些共振結構的分子 CO2 的圖所示。解釋為什麼其中一些很可能是意義不大在描述這種分子的結合

9.100 (a) This is a very good resonance form; there are no formal charges and each atom satisfies the octet rule.

(b) This is a second choice after (a) because of the positive formal charge on the oxygen (high electronegativity).

(c) This is a poor choice for several reasons. The formal charges are placed counter to the electronegativities of C and O, the oxygen atom does not have an octet, and there is no bond between that oxygen and carbon!

(d) This is a mediocre choice because of the large formal charge and lack of an octet on carbon.

9.110 (a) From the following data calculate the bond enthalpy of the F2 2 ion.

（a）從以下數據計算出 F 22 離子的鍵焓。

$$F_2(g) \longrightarrow 2F(g) \qquad \Delta H^\circ_{rxn} = 156.9\ \text{kJ/mol}$$
$$F^-(g) \longrightarrow F(g) + e^- \qquad \Delta H^\circ_{rxn} = 333\ \text{kJ/mol}$$
$$F_2^-(g) \longrightarrow F_2(g) + e^- \qquad \Delta H^\circ_{rxn} = 290\ \text{kJ/mol}$$

(b) Explain the difference between the bond enthalpies of F2 and F2 2.

解釋 F2 的鍵焓和 F22 之間的差異。

9.110 (a) The bond enthalpy of F_2^- is the energy required to break up F_2^- into an F atom and an F^- ion.

$$F_2^-(g) \longrightarrow F(g) + F^-(g)$$

We can arrange the equations given in the problem so that they add up to the above equation. SeeSection 6.6 of the text (Hess's law).

$$\begin{aligned}
&F_2^-(g) \longrightarrow F_2(g) + e^- && \Delta H^\circ = 290 \text{ kJ/mol}\\
&F_2(g) \longrightarrow 2F(g) && \Delta H^\circ = 156.9 \text{ kJ/mol}\\
&F(g) + e^- \longrightarrow F^-(g) && \Delta H^\circ = -333 \text{ kJ/mol}\\
&\overline{F_2^-(g) \longrightarrow F(g) + F^-(g)}
\end{aligned}$$

The bond enthalpy of F_2^- is the sum of the enthalpies of reaction.

$$\text{BE}(\mathbf{F_2^-}) = [290 + 156.9 + (-333 \text{ kJ})]\text{kJ/mol} = \mathbf{114 \text{ kJ/mol}}$$

(b) The bond in F_2^- is weaker (114 kJ/mol) than the bond in F_2 (156.9 kJ/mol), because the extra electron increases repulsion between the F atoms.

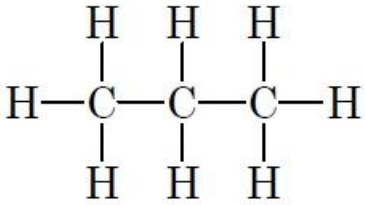
9.120 Experiments show that it takes 1656 kJ/mol to break all the bonds in methane (CH4) and 4006 kJ/mol to break all the bonds in propane (C3H8). Based on these data, calculate the average bond enthalpy of the COC bond.

9.120 實驗表明，它需要 1656 千焦/摩爾斷裂所有的鍵的甲烷（CH4）和 4006 千焦/摩爾斷裂所有的鍵的丙烷（C3H8）。基於這些數據，計算 COC 鍵的平均鍵焓。

9.120 There are four C–H bonds in CH_4, so the average bond enthalpy of a C–H bond is:

$$\frac{1656 \text{ kJ/mol}}{4} = 414 \text{ kJ/mol}$$

The Lewis structure of propane is:



There are eight C–H bonds and two C–C bonds. We write:

$$8(\text{C–H}) + 2(\text{C–C}) = 4006 \text{ kJ/mol}$$

$$8(414 \text{ kJ/mol}) + 2(\text{C–C}) = 4006 \text{ kJ/mol}$$

$$2(\text{C–C}) = 694 \text{ kJ/mol}$$

So, the average bond enthalpy of a C–C bond is: $\frac{694}{2}$ kJ/mol = **347 kJ/mol**

9.130 The bond enthalpy of the CON bond in the amide group of proteins (see Problem 9.81) can be treated as an average of CON and CPN bonds. Calculate the maximum wavelength of light needed to break the bond.

蛋白質的酰胺基中的 CON 鍵的鍵焓可以被視為平均 CON 和 CPN 鍵。計算打破鍵所需的光的最大波長。

9.130 From Table 9.4 of the text, we can find the bond enthalpies of C−N and C=N. The average can be calculated, and then the maximum wavelength associated with this enthalpy can be calculated.

The average bond enthalpy for C−N and C=N is:

從文表 9.4 中，我們可以發現 C-N 和 C= N 的結合焓。平均可以計算，然後用此焓相關聯的最大波長可以計算出來。平均鍵焓 C-N 和 C= N 為：

$$\frac{(276 + 615)\,\text{kJ/mol}}{2} = 446\ \text{kJ/mol}$$

We need to convert this to units of J/bond before the maximum wavelength to break the bond can be calculated. Because there is only 1 CN bond per molecule, there is Avogadro's number of bonds in 1 mole of the amide group.

我們需要的最大波長轉換之前，這對焦耳/鍵單元打破鍵能計算。因為每個分子只有 1 CN 鍵，有在 1 摩爾的鍵阿伏伽德羅常數酰胺基。

$$\frac{446\ \text{kJ}}{1\ \text{mol}} \times \frac{1\ \text{mol}}{6.022 \times 10^{23}\ \text{bonds}} \times \frac{1000\ \text{J}}{1\ \text{kJ}} = 7.41 \times 10^{-19}\ \text{J/bond}$$

The maximum wavelength of light needed to break the bond is:

$$\lambda_{\text{max}} = \frac{hc}{E} = \frac{(6.63 \times 10^{-34}\ \text{J}\cdot\text{s})(3.00 \times 10^{8}\ \text{m/s})}{7.41 \times 10^{-19}\ \text{J}} = \mathbf{2.68 \times 10^{-7}\ m = 268\ nm}$$